PB-245 845

LOCH RAVEN RESERVOIR, BALTIMORE COUNTY, MARYLAND

Pacific Northwest Environmental Research Laboratory

Prepared for:

National Environmental Research Center

June 1975

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U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT

ON

LOCH RAVEN RESERVOIR

BALTIMORE COUNTY

MARYLAND

EPA REGION III

WORKING PAPER No. 358

PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY

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REPORT
ON
LOCH RAVEN RESERVOIR
BALTIMORE COUNTY
MARYLAND
EPA REGION III
WORKING PAPER No. 358

WITH THE COOPERATION OF THE
MARYLAND DEPARTMENT OF NATURAL RESOURCES,
MARYLAND DEPARTMENT OF HEALTH AND MENTAL HYGIENE,
AND THE
MARYLAND NATIONAL GUARD

JUNE, 1975

TECHNICAL REPORT DATA (Please read Instructions on the reverse before completing)		
1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Report on Lock Raven Reservoir, Baltimore County, Maryland		5. REPORT DATE Prepared June, 1975 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Anonymous (National Eutrophication Survey Staff)		8. PERFORMING ORGANIZATION REPORT NO. Working Paper No. 358
9. PERFORMING ORGANIZATION NAME AND ADDRESS National Eutrophication Survey U.S. Environmental Protection Agency P.O. Box 15027 Las Vegas, NV 89114		10. PROGRAM ELEMENT NO. 11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS Office of Research and Development U.S. Environmental Protection Agency 401 M Street, S. W. Washington, DC 20460		13. TYPE OF REPORT AND PERIOD COVERED Final - 1973 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

Prepared in cooperation with the U.S. Environmental Protection Agency, Corvallis Environmental Research Laboratory, Eutrophication Survey Branch, Corvallis, OR 97330

16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
eutrophication lakes nutrients phosphorus nitrogen loading	PRICES SUBJECT TO CHANGE	05B 05C

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO. OF PAGES
Release unlimited		55
	20. SECURITY CLASS (This page)	22. PRICE
		4.25 - 2.25

EPA Form 2220-1 (9-73)

REPORT ON LOCH RAVEN RESERVOIR

BALTIMORE COUNTY, MARYLAND, EPA REGION III

by

National Eutrophication Survey

Water and Land Monitoring Branch
Monitoring Applications Laboratory
National Environmental Research Center
Las Vegas, Nevada

and

Eutrophication Survey Branch
Pacific Northwest Environmental Research Laboratory
National Environmental Research Center
Corvallis, Oregon

Working Paper No. 358

OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY

June 1975

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin

planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Maryland Department of Natural Resources and the Maryland Department of Health and Mental Hygiene for professional involvement and to the Maryland National Guard for conducting the tributary sampling phase of the Survey.

Paul W. Slunt, Chief, Water Quality Services, James T. Allison, Natural Resources Manager, Water Quality Services, of the Maryland Department of Natural Resources, and Earl S. Quance, Chief, Division of Water and Sewerage, Maryland Department of Health and Mental Hygiene provided invaluable lake documentation and counsel during the course of the Survey.

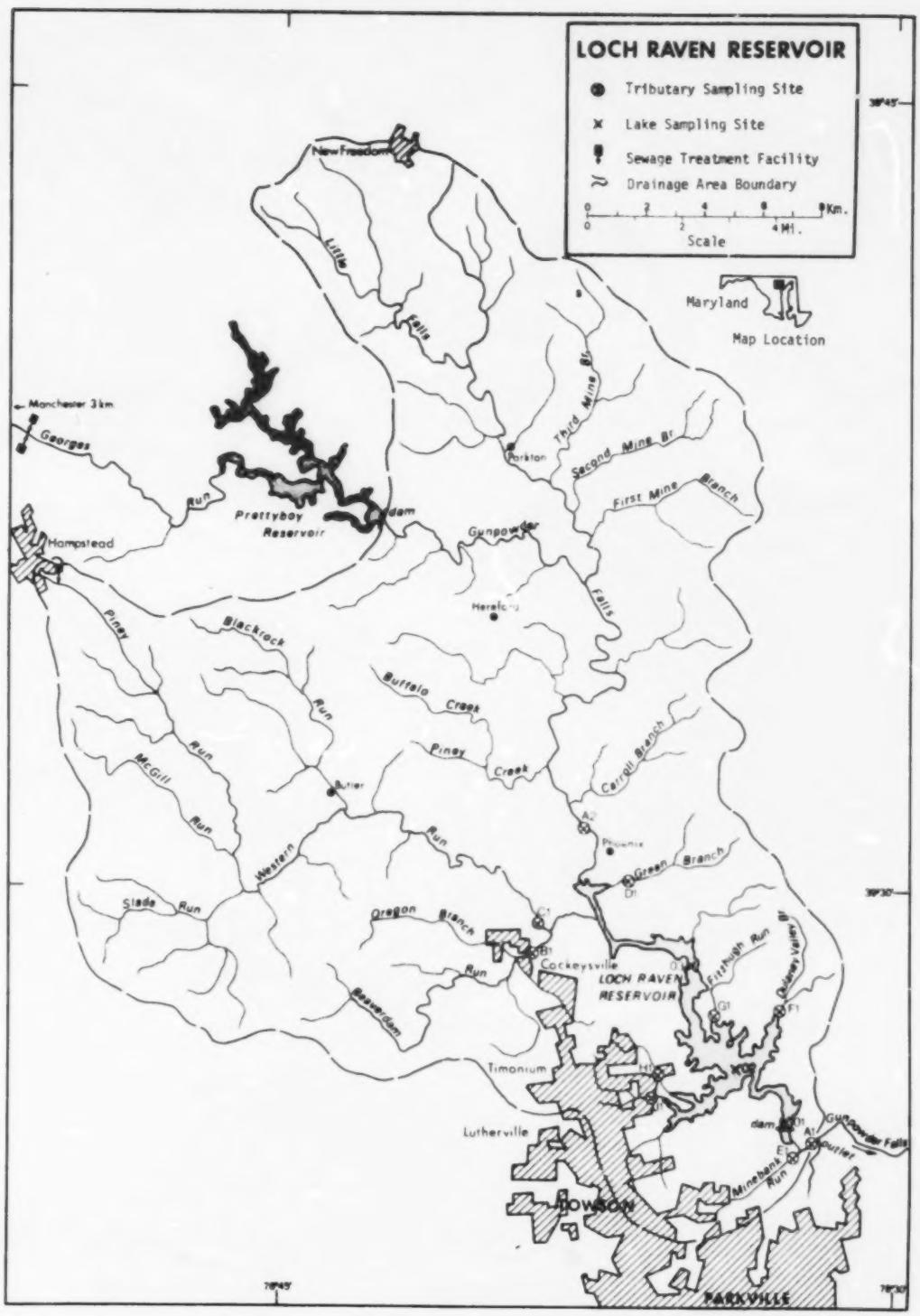
Major General Edwin Warfield III, the Adjutant General of Maryland, and Project Officer Colonel Bernard Feingold, who directed the volunteer efforts of the Maryland National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MARYLAND

LAKE NAME	COUNTY
Deep Creek Lake	Garrett
Liberty Reservoir	Carroll, Baltimore
Loch Raven Reservoir	Baltimore
Johnson Pond	Wicomico


LOCH RAVEN RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Drainage Area Boundary
Km.
Mi.
Scale
Maryland
Map Location
New Freedom
Little Falls
Third Mine Br
Second Mine Br
First Mine Branch
Manchester 3 km
Georges Run
Prettyboy Reservoir
dam
Hampstead
Gunpowder Falls
Piney Run
Blackrock Run
Buffalo Creek
Piney Creek
McGill Run
Western Run
Slade Run
Oregon Branch
Run
Beaverdam Run
Cockeysville
LOCH RAVEN RESERVOIR
Timonium
Lutherville
Carroll Branch
Green Branch
Fitchugh Run
Quarry Valley Br
Minebanks Run
TOWSON
PARKVILLE

LOCH RAVEN RESERVOIR

STORET NO. 2408

I. CONCLUSIONS

A. Trophic Condition*:

Loch Raven Reservoir is classified as eutrophic based upon survey data. Chlorophyll a levels and potential for primary productivity as measured by algal assay control yields were moderate, and oxygen depletion occurred below 6.1 meters during July and October. Nutrient concentrations were low, and Secchi disc visibility ranged from a low of 0.5 meters in the spring to a high of 3.0 meters in the fall. Survey limnologists did not report any nuisance conditions; however, past studies (State of Maryland, 1970; Jansson and Rudich, 1973) have reported algal blooms, suds from dairy farm detergent usage and other problem conditions in tributaries impacting the reservoir.

B. Rate-Limiting Nutrient:

Algal assay results indicate that Loch Raven Reservoir was limited by available phosphorus levels. Spikes with phosphorus, and nitrogen and phosphorus simultaneously result in increases in assay yield. Additions of nitrogen alone did not stimulate a growth response. The ratio of available nitrogen to phosphorus in sampled waters substantiates phosphorus limitation.

* See Appendix E

C. Nutrient Controllability:

1. Point Sources -

The mean annual phosphorus load from point sources was estimated to be 28.7% of the total load reaching Loch Raven Reservoir. The city of Manchester contributed a total of 15.1% from two wastewater treatment plants, and the city of Hampstead contributed 13.6%.

The present loading rate of 1.45 $g/m^2/yr$ is less than that proposed by Vollenweider (in press) as "dangerous" (eutrophic) for a lake of such volume and detention time, but greater than the "permissible" (oligotrophic) rate. Total elimination of the known point sources impacting the reservoir would lower annual loading to the "permissible" rate.

2. Nonpoint Sources -

The mean annual phosphorus load from nonpoint sources was about 71.3% of the total reaching the lake. Measured tributaries accounted for 64.9% of the total impacting the lake, and ungaged tributaries accounted for 6.4%.

Numerous recommendations were made (State of Maryland, 1970) by State officials to assure the continuation of existing water quality in Loch Raven Reservoir. Included in these recommendations are a proposal for an intensive sanitary survey of all communities in the reservoir watershed which are without public sewerage facilities, and a suggestion

to amend the State Sediment Control Act to include agricultural land management practices. At this time, it is not known what action has been taken on these recommendations.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below. Lake morphometry was provided by the State of Maryland; tributary data were provided by the Maryland District Office of the U.S. Geological Survey (USGS) (outlet drainage area includes the lake surface area). Mean hydraulic retention time was obtained by dividing the lake volume by mean flow of the outlet. The outlet data for normalized flow and daily and monthly flows for time of sampling were divided into spillage and diversion segments. The spillage and diversions were combined to determine total outflow.

Tributary drainage areas plus the lake surface area do not equal the outlet drainage area (probably) because of differences in pool elevation used by the different sources in their calculations. Precipitation values are estimated by methods as outlined in National Eutrophication Survey (NES) Working Paper No. 175. A table of metric/English conversions is included as Appendix D.

A. Lake Morphometry:

1. Surface area: 7.67 km^2.
2. Mean depth: 15.2 meters.
3. Maximum depth: 21.3 meters.
4. Volume: 116.569 x 10^6 m^3.
5. Mean hydraulic retention time: 146 days.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area(km^2)	Mean flow (m^3/sec)
A(2) Gunpowder Falls	466.2	5.53
B(1) Beaverdam Run	54.4	0.65
C(1) Western Run	163.7	1.76
D(1) Greene Branch	11.9	0.16
F(1) Dulaney Valley Branch	8.3	0.13
G(1) Fitzhugh Run	4.1	0.07
H(1) Unnamed Stream	3.6	0.04
J(1) Spring Branch	4.5	0.04
Minor tributaries & immediate drainage	58.8	0.67
Totals	775.5	9.05
2. Outlet - A(1) Gunpowder Falls River	791.6	9.21

C. Precipitation:

1. Year of sampling: 105.4 centimeters.

2. Mean annual: 139.7 centimeters.

III. LAKE WATER QUALITY SUMMARY

Loch Raven Reservoir was sampled three times during the open-water season of 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from a number of depths at each station (see map, page v). During each visit, depth-integrated samples were collected from each station for chlorophyll a analysis and phytoplankton identification and enumeration. During the first visit, 18.9-liter depth-integrated samples were composited for algal assays. Maximum depths sampled were 21.6 meters at Station 1, 18.0 meters at Station 2, and 14.0 meters at Station 3. For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix B and are summarized in III A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll a determinations are included in III B. Results of the limiting study are presented in III C.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR LOCH RAVEN RESERVOIR
STORET CODE 2408

PARAMETER	1ST SAMPLING (4/11/73) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/21/73) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (10/ 1/73) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	9.8 - 10.6	10.2	10.2	9.2 - 27.9	21.0	22.9	9.4 - 21.6	16.9	18.3
DISS OXY (MG/L)	10.0 - 10.8	10.4	10.4	0.4 - 10.8	5.1	5.1	0.2 - 8.6	3.2	0.8
CNDCTVY (MCROMO)	130. - 150.	139.	140.	97. - 153.	129.	134.	107. - 141.	129.	131.
PH (STAND UNITS)	6.3 - 7.1	6.7	6.7	6.6 - 9.2	7.7	7.1	6.6 - 7.8	7.0	6.8
TOT ALK (MG/L)	30. - 44.	38.	40.	23. - 49.	40.	40.	39. - 66.	46.	42.
TOT P (MG/L)	0.023 - 0.098	0.050	0.042	0.012 - 0.041	0.019	0.018	0.016 - 0.089	0.031	0.024
ORTHO P (MG/L)	0.004 - 0.012	0.007	0.005	0.003 - 0.008	0.006	0.005	0.006 - 0.012	0.009	0.008
NO2+NO3 (MG/L)	1.600 - 1.900	1.642	1.600	0.980 - 1.700	1.341	1.300	0.060 - 1.300	0.802	0.940
AMMONIA (MG/L)	0.040 - 0.070	0.055	0.060	0.020 - 0.360	0.089	0.060	0.050 - 1.430	0.394	0.200
KJEL N (MG/L)	0.200 - 0.700	0.433	0.400	0.200 - 0.800	0.507	0.500	0.200 - 1.500	0.624	0.580
INORG N (MG/L)	1.640 - 1.960	1.697	1.660	1.000 - 1.800	1.429	1.450	1.050 - 1.490	1.196	1.130
TOTAL N (MG/L)	1.900 - 2.300	2.075	2.050	1.180 - 2.200	1.848	1.895	1.140 - 1.810	1.426	1.410
CHLRPYL A (UG/L)	3.2 - 6.1	4.8	5.1	7.7 - 13.0	11.0	12.2	5.1 - 6.0	5.6	5.8
SECCHI (METERS)	0.5 - 0.9	0.7	0.9	1.8 - 2.1	2.0	2.0	2.1 - 3.0	2.6	2.7

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera		Algal Units per ml
04/11/73	1.	Flagellates	712
	2.	Fragilaria	597
	3.	Asterionella	394
	4.	Cryptomonas	140
	5.	Oscillatoria	63
		Other genera	204
		Total	2,110
07/21/73	1.	Fragilaria	3,659
	2.	Cyclotella	570
	3.	Melosira	480
	4.	Flagellates	210
	5.	Oocystis	180
		Other genera	239
		Total	5,338
10/01/73	1.	Fragilaria	1,198
	2.	Melosira	480
	3.	Flagellates	189
	4.	Coelosphaerium	103
	5.	Stephanodiscus	69
		Other genera	240
		Total	2,279

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (micrograms/l)
04/11/73	1	6.1
	2	5.1
	3	3.2
07/21/73	1	13.0
	2	12.2
	3	7.7
10/01/73	1	6.0
	2	5.8
	3	5.1

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike(mg/l)	Ortho P Conc.(mg/l)	Inorganic N Conc.(mg/l)	Maximum Yield (mg/l-dry wt.)
Control	0.016	1.568	1.0
0.05 P	0.066	1.568	8.1
0.05 P + 1.0 N	0.066	2.568	14.7
1.00 N	0.016	2.568	1.2

2. Discussion -

The control yield of the assay alga, Selanastrum capricornutum, indicates that the potential for primary production in Loch Raven Reservoir was moderately high at the time of sampling. The increase in yield with the addition of phosphorus indicates phosphorus limitation.

Spikes of nitrogen alone produced no positive growth response. Maximum growth potential was achieved with the simultaneous addition of both phosphorus and nitrogen.

The ratio of inorganic nitrogen to dissolved phosphorus was about 207:1 in the field samples for Loch Raven Reservoir, indicating the lake was phosphorus limited at the time of assay sample collection.

IV. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the Maryland National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff month of March when three samples were collected. Sampling was begun in May 1973, and was completed in May 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Maryland District Office of the USGS for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of the USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean annual concentrations in Beaverdam Run, Greene Branch, Dulaney Valley Branch, Fitzhugh Run, Unnamed Stream, and Spring Branch at Station B(1), D(1), F(1), G(1), H(1), J(1), and mean annual ZZ flow.

The operators of Hampstead, Manchester, and Dutterer's wastewater treatment plants provided monthly effluent samples and corresponding flow data.

A. Waste Sources:

1. Known municipal -

Name	Population Served	Treatment	Mean Flow ($m^3/d \times 10^3$)	Receiving Water
Hampstead	3,000	Activated Sludge	0.757	Piney Run, Western Run
Manchester	1,000	Activated Sludge	0.271	Georges Run, Prettyboy Reservoir, Gunpowder Falls

2. Known industrial -

Name	Product	Treatment	Mean Flow ($m^3/d \times 10^3$)	Receiving Water
Cutterer's (Manchester)	Meat packing	Activated Sludge	0.114	Georges Run, Prettyboy Reservoir, Gunpowder Falls

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (nonpoint load) -		
A(2) Gunpowder Falls	4,385	39.5
B(1) Beaverdam Run	350	3.1
C(1) Western Run	1,745	15.7
D(1) Greene Branch	90	0.8
F(1) Dulaney Valley Branch	400	3.6
G(1) Fitzhugh Run	55	0.5
H(1) Unnamed Stream	35	0.3
J(1) Spring Branch	25	0.2
b. Minor tributaries & immediate drainage (nonpoint load) -	715	6.4
c. Known municipal STP's -		
Hampstead	1,510	13.6
Manchester	1,645	14.8
d. Septic tanks - Unknown		
e. Known industrial -		
Dutterer's (Manchester)	30	0.3
f. Direct precipitation* -	135	1.2
Total	11,120	100.0

2. Outputs - Gunpowder Falls River 7,775

3. Net annual P accumulation - 3,345 kg.

*Estimated.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (nonpoint load) -		
A(2) Gunpowder Falls	360,885	57.7
B(1) Beaverdam Run	41,535	6.6
C(1) Western Run	124,250	19.8
D(1) Greene Branch	12,110	1.9
F(1) Dulaney Valley Branch	13,360	2.1
G(1) Fitzhugh Run	4,970	0.8
H(1) Unnamed Stream	3,030	0.5
J(1) Spring Branch	2,400	0.4
b. Minor tributaries & immediate drainage (nonpoint load) -	50,355	8.1
c. Known municipal STP's -		
Hampstead	1,760	0.3
Manchester	2,540	0.4
d. Septic tanks - Unknown		
e. Known industrial -		
Dutterer's (Manchester)	370	0.1
f. Direct precipitation* -	8,280	1.3
Total	625,845	100.0

2. Outputs - Gunpowder Falls River 436,650

3. Net annual N accumulation - 189,195 kg.

*Estimated.

D. Mean Annual Nonpoint Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
A(2) Gunpowder Falls	9	774
B(1) Beaverdam Run	6	763
C(1) Western Run	11	759
D(1) Greene Branch	8	1,018
F(1) Dulaney Valley Branch	48	1,610
G(1) Fitzhugh Run	13	1,212
H(1) Unnamed Stream	10	842
J(1) Spring Branch	6	533

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving waters would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

	Total Yearly Phosphorus Loading Rate (grams/m^2/year
Estimated loading rate for Loch Raven Reservoir	1.45
Vollenweider's "dangerous" or eutrophic rate	2.10
Vollenweider's "permissible" or oligotrophic rate	1.05

V. LITERATURE REVIEWED

Jansson, Erik and David Rudich. 1973. "Gunpowder Watershed Pollution Abatement Study." Department of Natural Resources. Annapolis, Maryland.

State of Maryland. 1970. "Loch Raven Reservoir Watershed Sanitary Survey." Department of Health.

U.S. Environmental Protection Agency. 1975. "National Eutrophication Survey Methods 1973-1976." Working Paper No. 175. National Environmental Research Center, Las Vegas, Nevada and Pacific Northwest Environmental Research Laboratory, Corvallis, Oregon.

Vollenweider, Richard A. (in press). "Input-Output Models." Schweiz Z. Hydrol.

VI. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR MARYLAND 9/16/75

LAKE CODE 2408 LOCH RAVEN RESERVOIR

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 800.3

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
2408A1	800.3	1.73	4.47	6.06	6.03	4.19	2.49	0.65	2.01	1.22	0.91	1.22	1.84	2.72
2408A2	466.2	4.93	7.39	7.84	7.59	6.06	4.36	3.45	5.32	4.53	4.47	5.69	4.90	5.53
2408B1	54.4	0.74	0.88	0.93	0.85	0.76	0.62	0.57	0.51	0.42	0.40	0.51	0.59	0.65
2408C1	163.7	2.15	2.61	2.78	2.49	2.24	1.81	1.64	1.47	1.22	1.10	1.50	0.18	1.76
2408D1	11.9	0.18	0.22	0.24	0.21	0.19	0.16	0.14	0.13	0.10	0.10	0.13	0.15	0.16
2408E1	8.7	0.06	0.07	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.03	0.04	0.05	0.05
2408F1	8.3	0.15	0.18	0.19	0.17	0.16	0.13	0.12	0.11	0.09	0.08	0.11	0.13	0.13
2408G1	4.1	0.07	0.09	0.09	0.08	0.08	0.06	0.06	0.05	0.05	0.04	0.05	0.06	0.07
2408H1	3.6	0.05	0.06	0.06	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.04	0.04
2408J1	4.5	0.04	0.05	0.05	0.05	0.05	0.04	0.03	0.03	0.03	0.03	0.03	0.04	0.04
2408K1	800.3	6.54	6.91	6.57	6.34	6.54	6.40	6.82	7.11	6.68	6.29	6.06	6.29	6.54
2408ZZ	58.8	0.76	0.93	0.96	0.88	0.79	0.65	0.59	0.54	0.42	0.40	0.54	0.62	0.67

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 800.3
SUM OF SUB-DRAINAGE AREAS = 784.2

TOTAL FLOW IN = 109.57
TOTAL FLOW OUT = 111.37

NOTE *** SEE WRITE-UP ON LOCH RAVEN RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
2408A1	5	73	13.39	12	8.50				
	6	73	7.73	9	8.21				
	7	73	2.21	14	0.16				
	8	73	0.65	11	0.10				
	9	73	0.08	9	0.06				
	10	73	0.07	14	0.07				
	11	73	0.07	10	0.07				
	12	73	6.68	9	0.27				
	1	74	5.18	12	9.66				
	2	74	1.76	8	2.10	13	1.42		
	3	74	4.47	2	0.82	10	1.08	17	0.82
2408A2	5	73	10.02	0	0.0				
	6	73	7.31	0	0.0				
	7	73	4.73	0	0.0				
	8	73	4.67	0	0.0				
	9	73	4.50	9	2.35				
	10	73	4.93	14	2.32				
	11	73	3.57	10	1.30				
	12	73	9.91	9	19.82				
	1	74	4.73	12	6.12				
	2	74	2.94	8	4.05	13	2.80		
	3	74	4.22	2	3.11	10	2.75	17	3.45

TRIBUTARY FLOW INFORMATION FOR MARYLAND 9/16/75

LAKE CODE 2408 LOCH RAVEN RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
2408B1	5	73	1.50	12	1.16				
	6	73	1.16	9	1.13				
	7	73	0.76	14	0.71				
	8	73	0.59	11	0.62				
	9	73	0.51	9	0.37				
	10	73	0.48	14	0.40				
	11	73	0.42	10	0.42				
	12	73	0.99	9	1.67				
	1	74	0.99	12	1.36				
	2	74	0.74	8	0.79	13	0.79		
	3	74	0.79	2	0.65	10	0.65	17	0.65
2408C1	5	73	4.73	12	3.60				
	6	73	3.60	9	3.48				
	7	73	2.27	14	2.10				
	8	73	1.70	11	1.84				
	9	73	1.47	9	1.05				
	10	73	1.42	14	1.13				
	11	73	1.22	10	1.16				
	12	73	3.00	9	5.38				
	1	74	2.97	12	4.25				
	2	74	2.21	8	2.38	13	2.32		
	3	74	2.35	2	1.93	10	1.93	17	1.93
2408D1	5	73	0.40	12	0.31				
	6	73	0.31	9	0.28				
	7	73	0.19	14	0.18				
	8	73	0.15	11	0.16				
	9	73	0.12	9	0.09				
	10	73	0.12	14	0.10				
	11	73	0.10	10	0.10				
	12	73	0.25	9	0.45				
	1	74	0.25	12	0.37				
	2	74	0.19	8	0.20	13	0.20		
	3	74	0.20	2	0.16	10	0.16	17	0.16
2408E1	5	73	0.13	12	0.10				
	6	73	0.10	9	0.10				
	7	73	0.07	14	0.06				
	8	73	0.05	11	0.05				
	9	73	0.04	9	0.03				
	10	73	0.04	14	0.03				
	11	73	0.04	10	0.03				
	12	73	0.08	9	0.14				
	1	74	0.08	12	0.12				
	2	74	0.06	8	0.07	13	0.07		
	3	74	0.07	2	0.06	10	0.06	17	0.06

TRIBUTARY FLOW INFORMATION FOR MARYLAND 9/16/75

LAKE CODE 2408 LOCH RAVEN RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
2408F1	5	73	0.31	12	0.24				
	6	73	0.24	9	0.23				
	7	73	0.16	14	0.15				
	8	73	0.12	11	0.13				
	9	73	0.11	9	0.08				
	10	73	0.10	14	0.08				
	11	73	0.09	10	0.09				
	12	73	0.20	9	0.34				
	1	74	0.20	12	0.27				
	2	74	0.16	8	0.16	13	0.16		
	3	74	0.16	2	0.14	10	0.14	17	0.14
2408G1	5	73	0.15	12	0.12				
	6	73	0.12	9	0.11				
	7	73	0.08	14	0.07				
	8	73	0.06	11	0.07				
	9	73	0.05	9	0.04				
	10	73	0.05	14	0.04				
	11	73	0.05	10	0.04				
	12	73	0.10	9	0.16				
	1	74	0.10	12	0.14				
	2	74	0.08	8	0.08	13	0.08		
	3	74	0.08	2	0.07	10	0.07	17	0.07
2408H1	5	73	0.10	12	0.08				
	6	73	0.08	9	0.07				
	7	73	0.05	14	0.05				
	8	73	0.04	11	0.04				
	9	73	0.03	9	0.02				
	10	73	0.03	14	0.03				
	11	73	0.03	10	0.03				
	12	73	0.07	9	0.11				
	1	74	0.07	12	0.09				
	2	74	0.05	8	0.05	13	0.05		
	3	74	0.05	2	0.04	10	0.04	17	0.04
2408J1	5	73	0.09	12	0.07				
	6	73	0.07	9	0.07				
	7	73	0.05	14	0.04				
	8	73	0.03	11	0.04				
	9	73	0.03	9	0.02				
	10	73	0.03	14	0.03				
	11	73	0.03	10	0.03				
	12	73	0.06	9	0.10				
	1	74	0.06	12	0.08				
	2	74	0.05	8	0.05	13	0.05		
	3	74	0.05	2	0.04	10	0.04	17	0.04

TRIBUTARY FLOW INFORMATION FOR MARYLAND 9/16/75

LAKE CODE 2408 LOCH RAVEN RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
2408X1	5	73	5.61	12	5.78				
	6	73	6.97	9	6.29				
	7	73	7.82	14	8.01				
	8	73	8.30	11	8.10				
	9	73	8.01	9	7.76				
	10	73	7.56	14	7.19				
	11	73	6.68	10	5.61	15	5.41		
	12	73	6.54	9	4.56				
	1	74	5.61	12	5.41				
	2	74	5.69	8	5.95	13	5.97		
	3	74	3.11	2	5.41	10	5.15	17	5.35
2408Z2	5	73	1.61	12	1.25				
	6	73	1.25	9	1.22				
	7	73	0.79	14	0.74				
	8	73	0.62	11	0.65				
	9	73	0.54	9	0.37				
	10	73	0.51	14	0.40				
	11	73	0.45	10	0.42				
	12	73	1.05	9	1.84				
	1	74	1.05	12	1.47				
	2	74	0.79	8	0.85	13	0.82		
	3	74	0.82	2	0.68	10	0.68	17	0.68

APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/09/16

240801
39 25 55.0 076 32 37.0
LOCH RAVEN RESERVOIR
24005 MARYLAND

11EPALES
3

2111202
0030 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/11	11 50	0000	10.1		35	141	6.40	39	0.040	0.200	1.000	0.005
	11 50	0004	10.0	10.6		140	6.30	40	0.040	0.300	1.000	0.005
	11 50	0015	10.0	10.6		145	7.00	41	0.040	0.300	1.000	0.004
	11 50	0025	9.8	10.8		148	7.10	42	0.040	0.400	1.000	0.004
73/07/21	13 25	0000	27.8		78	148	9.20	40	0.060	0.800	1.200	0.006
	13 25	0005	27.3	10.6		146	9.10	39	0.040	0.700	1.200	0.006
	13 25	0015	22.6	5.4		130	6.90	38	0.060	0.700	1.500	0.006
	13 25	0025	15.9	0.4		108	6.60	39	0.030	0.700	1.500	0.005
	13 25	0040	11.8	1.2		97	6.60	23	0.020	0.200K	0.900	0.003
	13 25	0065	9.2			101	6.60	42	0.190	0.500	1.300	0.005
73/10/01	13 15	0000	21.6	8.6	120	135	7.40	44	0.070	0.500	0.900	0.008
	13 15	0015	21.1	6.6		139	7.20	42	0.070	0.300	1.000	0.008
	13 15	0025	19.3	0.4		129	6.80	42	0.190	0.400	0.940	0.012
	13 15	0035	14.3	0.8		111	6.70	45	0.200	0.300	0.920	0.008
	13 15	0045	11.9	0.6		107	6.60	48	0.330	0.300	0.840	0.007
	13 15	0067	9.4	0.6		141	6.60	66	1.430	1.500	0.060	0.012

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/11	11 50	0000	0.025	6.1
	11 50	0004	0.029	
	11 50	0015	0.033	
	11 50	0025	0.023	
73/07/21	13 25	0000	0.014	13.0
	13 25	0005	0.018	
	13 25	0015	0.019	
	13 25	0025	0.013	
	13 25	0040	0.012	
	13 25	0065	0.018	
73/10/01	13 15	0000	0.017	6.0
	13 15	0015	0.016	
	13 15	0025	0.026	
	13 15	0035	0.021	
	13 15	0045	0.017	
	13 15	0067	0.024	

A VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

240802
39 26 57.0 076 33 47.0
LOCH RAVEN RESERVOIR
24005 MARYLAND

11EPALES
3

2111202
0044 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/11	12 20	0000	10.2		35	140	6.50	40	0.060	0.400	1.900	0.005
	12 20	0004	10.2	10.4		140	6.70	41	0.060	0.300	1.600	0.006
	12 20	0015	10.2	10.4		138	6.50	41	0.060	0.300	1.600	0.005
	12 20	0040	10.2	10.4		150	7.00	44	0.060	0.700	1.600	0.007
73/07/21	13 55	0000	27.5		72	152	8.90	42	0.060	0.500	1.300	0.004
	13 55	0005	27.4	9.8		153	8.70	43	0.060	0.500	1.200	0.008
	13 55	0015	23.2	4.8		132	7.00	40	0.090	0.400	1.490	0.007
	13 55	0037	12.1	1.2		100	6.70	38	0.070	0.300	1.600	0.005
73/10/01	10 50	0000	21.4	8.0	108	139	7.80	42	0.050	0.500	1.020	0.007
	10 50	0015	21.3	7.6		140	7.50	40	0.050	0.400	1.010	0.006
	10 50	0025	19.0	2.6		133	7.00	39	0.130	0.300	1.300	0.008
	10 50	0030	18.0			128						
	10 50	0035	14.8	0.2		117	6.80	41	0.330	0.500	0.770	0.008
	10 50	0040	12.9	0.3		115	6.70	45	0.510	0.700	0.620	0.007
	10 50	0055	10.7	0.8		129	6.70	57	1.170	1.400	0.080	0.007

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/11	12 20	0000	0.047	5.1
	12 20	0004	0.043	
	12 20	0015	0.042	
	12 20	0040	0.041	
73/07/21	13 55	0000	0.016	12.2
	13 55	0005	0.022	
	13 55	0015	0.021	
	13 55	0037	0.018	
73/10/01	10 50	0000	0.017	5.8
	10 50	0015	0.019	
	10 50	0025	0.017	
	10 50	0035	0.027	
	10 50	0040	0.028	
	10 50	0055	0.024	

24

STORET RETRIEVAL DATE 75/09/16

240803
39 28 48.0 076 34 57.0
LOCH RAVEN RESERVOIR
24005 MARYLAND

11EPALES
3

2111202
0042 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/11	13 00	0000	10.6		18	136	6.90	31	0.060	0.600	1.600	0.012
	13 00	0004	10.6	10.0		130	6.90	32	0.070	0.500	1.600	0.010
	13 00	0015	10.6	10.0		130	6.70	31	0.060	0.500	1.600	0.008
	13 00	0038	10.4	10.0		135	6.60	30	0.070	0.700	1.600	0.008
73/07/21	15 50	0000	27.9		84	148	9.20	38	0.040	0.600	1.400	0.005
	15 50	0005	27.6	10.8		145	9.10	40	0.060	0.500	1.300	0.008
	15 50	0015	22.2	6.2		136	7.20	43	0.100	0.200K	1.700	0.006
	15 50	0036	12.1	0.8		112	6.70	49	0.360	0.500	1.100	0.005
73/10/01	10 15	0000	21.3	7.8	84	138	7.60	41	0.100	0.600	1.160	0.011
	10 15	0020	20.7	4.4		138	7.10	41	0.070	0.200K	1.260	0.009
	10 15	0030	18.6	3.2		133	6.80	41	0.240	0.600	1.210	0.011
	10 15	0035	14.8	0.6		125	6.70	51	0.700	0.800	0.400	0.009
	10 15	0042	12.8	0.6		129	6.70	59	1.060	1.300	0.070	0.008

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/11	13 00	0000	0.073	3.2
	13 00	0004	0.072	
	13 00	0015	0.074	
	13 00	0038	0.098	
73/07/21	15 50	0000	0.018	7.7
	15 50	0005	0.019	
	15 50	0015	0.023	
	15 50	0036	0.041	
73/10/01	10 15	0000	0.019	5.1
	10 15	0020	0.029	
	10 15	0030	0.089	
	10 15	0035	0.056	
	10 15	0042	0.085	

K VALUE KNOWN TO BE
LESS THAN INDICATED

25

APPENDIX C

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 75/09/16

2408A1
39 25 33.0 076 31 47.0
GUNPOWDER FALLS
24013 7.5 TOWSON
O/LOCH RAVEN RESERVOIR
GLENARM RD BRDG S OF SUMMERFIELD FARMS
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	13 35		1.440	0.240	0.013	0.010	0.080
73/06/09	12 45		1.440	0.230	0.020	0.005K	0.035
73/07/14	14 50		1.160	0.330	0.048	0.005K	0.015
73/08/11	11 00		1.120	0.290	0.031	0.009	0.025
73/09/09	13 55		0.510	0.690	0.015	0.012	0.040
73/10/14	11 00		0.570	1.200	0.018	0.015	0.105
73/11/10	12 05		0.740	0.450	0.060	0.010	0.030
73/12/09	10 40		0.560	0.900	0.048	0.032	
74/02/13	10 15		1.340	0.200	0.040	0.005	0.025
74/03/02	11 10		1.400	0.300	0.015	0.005	0.030
74/03/10	10 15		1.760	0.400	0.010	0.005K	0.010
74/03/17	10 20		1.520	0.400	0.020	0.005K	0.020
74/05/11	14 40		1.340	0.200	0.015	0.005K	0.010

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

2408A2
39 38 50.0 076 37 30.0
GUNPOWDER FALLS
24 7.5 PHOENIX
I/LOCH RAVEN RESERVOIR
PHOENIX RD BRDG .5 MI NW OF PHOENIX
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	10 20		1.740	0.390	0.015	0.005K	0.020
73/06/09	09 20		1.660	0.170	0.009	0.006	0.045
73/07/14	18 20		1.720	0.520	0.027	0.005K	0.025
73/08/11	08 20		1.660	0.210	0.005K	0.009	0.030
73/09/09	08 40		1.660	0.320	0.021	0.011	0.015
73/10/14	09 22		1.500	2.300	0.060	0.006	0.015
73/11/10	13 40		1.820	0.100K	0.031	0.009	0.009
73/12/09	10 20		1.400	0.600	0.040	0.020	
74/01/12	08 40		1.400	1.000	0.098	0.022	0.075
74/02/08	08 40		1.800	0.200	0.020	0.015	0.015
74/03/02	09 00		1.760	0.300	0.015	0.005K	0.015
74/03/10	12 10		1.500	0.500	0.010	0.005K	0.020
74/03/17	08 15		1.840	0.400	0.030	0.005	0.015
74/05/11	12 20		1.510	0.200	0.010	0.005K	0.010

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

240881
39 29 05.0 076 38 46.0
BEAVERDAM RUN
24 7.5 COCKEYSVILLE
T/LOCH RAVEN RESERVOIR
BRDG HWY 45 N OF COCKEYSVILLE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	11 10		1.600	0.260	0.020	0.035	0.050
73/06/09	10 35		1.620	0.110	0.013	0.005K	0.030
73/07/14	08 35		1.720	0.190	0.011	0.010	0.010
73/08/11	08 30		1.700	0.200	0.005K	0.008	0.015
73/09/09	09 05		1.920	0.400	0.015	0.007	0.015
73/10/14	09 30		2.100	1.400	0.044	0.006	0.010
73/11/10	14 10		1.900	0.250	0.046	0.007	0.010
73/12/09	08 20		0.600		0.036	0.028	
74/01/12	09 00		1.600	0.300	0.052	0.005K	0.025
74/02/08	08 50		1.900	0.100K	0.020	0.010	0.010
74/03/02	09 20		1.900	0.300	0.020	0.005	0.015
74/03/10	10 00		1.800	0.400	0.005	0.005K	0.005
74/03/17	08 30		1.760	0.500	0.025	0.005K	0.010
74/05/11	12 35		1.360	0.200	0.010	0.005K	0.005

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

2408C1
39 29 35.0 076 38 40.0
WESTERN RUN
24 7.5 COCKEYSVILLE
T/LOCH RAVEN RESERVOIR
PAPER MILL RD BRDG SW OF ASHLAND
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	10 45		1.800	0.100K	0.005K	0.010	0.025
73/06/09	10 05		1.880	0.100K	0.008	0.012	0.045
73/07/14	08 55		1.960	0.230	0.023	0.021	0.045
73/08/11	09 00		1.740	0.320	0.005K	0.010	0.055
73/09/09	09 50		1.780	0.360	0.023	0.013	0.020
73/10/14	09 40		1.700	0.100K	0.007	0.008	0.015
73/11/10	14 30		1.940	0.100K	0.029	0.017	0.030
73/12/09	10 30		1.760	1.200	0.052	0.064	
74/01/12	09 20		1.760	0.600	0.056	0.048	0.150
74/02/08	09 00		2.600	0.100K	0.020	0.025	0.025
74/03/02	09 15		2.150	0.200	0.010	0.015	0.030
74/03/10	10 40		2.100	0.300	0.015	0.010	0.025
74/03/17	08 45		2.000	0.300	0.020	0.012	0.030
74/05/11	13 05		1.520	0.300	0.010	0.010	0.025

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

240801
39 30 20.0 076 36 25.0
GREENE BRANCH
24 7.5 PHOENIX
T/LOCH RAVEN RESERVOIR
PAPER MILL RD BRDG .5 MI UP FR RES
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	10 05		1.740	2.200	0.072	0.010	0.020
73/06/09	09 00		1.740	0.310	0.010	0.010	0.055
73/07/14	08 10		1.660	0.120	0.011	0.009	0.025
73/08/11	08 00		1.820	0.100K	0.005K	0.012	0.020
73/09/09	08 20		1.840	0.150	0.016	0.012	0.015
73/10/14	09 10		1.580	0.720	0.017	0.006	0.010
73/11/10	13 25		1.680	0.100K	0.025	0.009	0.009
73/12/09	10 00		1.010	3.500	0.128	0.076	
74/01/12	08 30		1.760	0.200	0.028	0.008	0.025
74/02/08	08 30		2.080	0.100K	0.015	0.010	0.010
74/03/02	08 45		1.840	0.200	0.015	0.010	0.010
74/03/10	10 00		1.900	0.300	0.010	0.005K	0.010
74/03/17	08 00		1.900	0.500	0.030	0.005K	0.010
74/05/11	12 00		1.440	0.400	0.015	0.005K	0.011

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

2408E1
39 25 20.0 076 32 20.0
MINEBANK RUN
24 7.5 TOWSON
T/LOCH RAVEN RESERVOIR
LOCH RAVEN RD BRDG
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	13 15		0.850	0.140	0.005K	0.008	0.020
73/06/09	12 20		1.320	0.130	0.010	0.006	0.020
73/07/14	14 35		0.980	0.320	0.018	0.005K	0.010
73/08/11	10 45		0.930	0.280	0.005K	0.007	0.007
73/09/09	13 40		0.800	0.270	0.046	0.008	0.008
73/10/14	10 50		1.680	0.630	0.005K	0.008	0.008
73/11/10	11 55		0.880	0.150	0.035		0.005
73/12/09	09 55		0.660	1.000	0.056	0.052	
74/01/12	10 45		1.340	0.300	0.024	0.008	0.020
74/02/08	10 15		1.280	0.100K	0.010	0.015	0.115
74/03/02	10 45		1.180	0.100	0.005K	0.010	0.010
74/03/10	10 45		1.200	0.600	0.015	0.005	0.010
74/03/17	10 00		1.280	0.500	0.030	0.005K	0.005
74/05/11	15 00		0.830	0.200	0.005K	0.005K	0.005K

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

2408F1
39 27 58.0 076 32 45.0
DULVANEY VALLEY BRANCH
24 7.5 TOWSON
T/LOCH RAVEN RESERVOIR
LOCH RAVEN RD BRDG
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	12 00		2.300	0.170	0.008	0.018	0.040
73/06/09	11 15		2.600	0.380	0.022	0.036	0.080
73/07/14	14 15		2.600	0.600	0.018	0.030	0.055
73/08/11	10 40		2.900	0.560	0.048	0.098	0.170
73/09/09	13 10		2.800	0.600	0.048	0.072	0.100
73/10/14	10 35		2.800	0.520	0.024	0.010	0.150
73/11/10	11 30		0.260		2.300	0.014	
73/12/09	09 45		1.440	1.700	0.092	0.140	
74/01/12	10 30		2.760	0.400	0.024	0.048	0.095
74/02/13	10 05		3.250	0.400	0.030	0.040	0.100
74/03/02	10 05		2.400	0.200	0.020	0.005	0.010
74/03/10	11 45		2.900	0.500	0.030	0.050	0.145
74/03/17	09 40		2.700	0.700	0.030	0.035	0.095
74/05/11	14 10		2.400	0.700	0.020	0.020	0.065

STORET RETRIEVAL DATE 75/09/16

240861
39 27 52.0 076 34 21.0
FITZHUGH RUN
24 7.5 TOWSON
T/LOCH RAVEN RESERVOIR
DULVANEY VLY RD BRDG
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	12 30		2.300	0.110	0.006	0.005K	0.010
73/06/09	11 00		2.200	0.160	0.012	0.005K	0.030
73/07/14	14 00		2.300	0.100K	0.015	0.005K	0.010
73/08/11	10 30		1.890	0.140	0.016	0.012	0.012
73/09/09	12 50		2.000	0.390	0.036	0.013	0.020
73/10/14	10 25		2.100	0.100K	0.012	0.006	0.006
73/11/10	11 20		1.940	0.100K	0.044	0.008	0.008
73/12/09	09 40		1.430	0.105	0.088	0.036	0.105
74/01/12	10 15		2.100	0.500	0.032	0.008	0.015
74/02/13	09 55		2.700	0.100K	0.020	0.005	0.005
74/03/02	10 25		2.900	0.600	0.035	0.055	0.125
74/03/10	11 30		2.300	0.300	0.015	0.005K	0.005K
74/03/17	09 20		2.200	0.300	0.035	0.005	0.010
74/05/11	14 00		1.920	0.100K	0.017	0.005K	0.005K

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

2408M1
39 26 45.0 076 35 45.0
UNNAMED STREAM
24 7.5 TOWSON
T/LOCH RAVEN RESERVOIR
DULVANEY VLY RD BRDG SE EDGE OF WAKEFIEL
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	12 15		2.100	0.100K	0.007	0.015	0.025
73/06/09	11 50		2.200	0.270	0.023	0.014	0.020
73/07/14	13 45		2.100	0.630	0.010	0.008	0.015
73/08/11	10 10		2.120	0.100K	0.009	0.022	0.025
73/09/09	12 20		1.800	0.290	0.029	0.027	0.032
73/10/14	10 10		1.900	0.500	0.034	0.023	0.055
73/11/10	10 55		1.900	0.100K	0.024	0.046	0.075
73/12/09	09 30		0.924	0.800	0.032	0.040	
74/01/12	09 40		1.920	0.300	0.020	0.005K	0.020
74/02/13	09 45		2.600	0.100K	0.015	0.005K	0.020
74/03/02	09 50		2.300	0.400	0.020	0.015	0.020
74/03/10	11 20		2.200	0.700	0.022	0.005	0.010
74/03/17	09 10		2.000	0.400	0.055	0.010	0.010
74/05/11	13 50		1.930	0.100K	0.010	0.010	0.025

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

2408J1
39 26 22.0 076 35 50.0
SPRING BRANCH
24 7.5 TOWSON
T/LOCH RAVEN RESERVOIR
DULVANEY VLY RD BRDG N OF VALLEY CREST
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	1[illegible] 00		1.700		0.005K	0.005K	0.015
73/06/09	11 40		1.900	0.110	0.010	0.006	0.010
73/07/14	13 45		1.720	0.100K	0.012	0.006	0.010
73/08/11	10 00		1.820	0.100K	0.010	0.017	0.017
73/09/09	12 00		1.620	0.100K	0.014	0.016	0.020
73/10/14	10 15		1.540	0.100K	0.013	0.008	0.010
73/11/10	10 45		1.140	0.100K	0.027	0.012	0.030
73/12/09	09 50		0.870	1.000	0.036	0.080	
74/01/12	10 00		2.160	0.300	0.032	0.024	0.030
	11 00		1.040	0.400	0.084	0.006	0.030
74/02/13	09 35		2.000	0.200	0.010	0.015	0.045
74/03/02	09 40		2.000	1.200	0.015	0.010	
74/03/10	13 15		1.920	0.600	0.010	0.005K	
74/03/17	09 00		1.850	0.300	0.020	0.005	0.007
74/05/11	13 30		1.340	0.200	0.010	0.010	0.020

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

2408K1
39 25 50.0 076 32 35.0
GUNPOWDER FALLS RIVER
24 7.5 TOWSON
O/LOCH RAVEN RESERVOIR
AT LOCH RAVEN DAM
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/11/15	15 00		0.800	0.400	0.147	0.005K	0.010
73/11/29	09 30		0.910	0.300	0.208	0.008	0.050
73/12/13	15 30		0.910	0.200	0.096	0.005K	0.010
73/12/28	11 00		1.090	0.200	0.076	0.008	0.010
74/01/15	13 00		1.440	0.100	0.012	0.005K	0.010
	14 00		1.120	0.200	0.044	0.008	0.015
74/02/14	11 00		1.340	0.200	0.030	0.010	0.020
74/02/28	11 00		1.440	0.300	0.010	0.005K	0.040
74/03/14	16 00		1.600	0.300	0.015	0.005K	0.010
74/03/28	13 00		1.010	0.300	0.085	0.010	0.040
74/04/15	16 15		1.090	0.300	0.050	0.010	0.010
74/04/30	13 00		0.920	0.300	0.020	0.005	0.060

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

2408AA AS2408AA P003000
39 36 07.0 076 50 30.0
HAMPSTEAD S.T.P.
24 CARROLL COUNTY
T/LOCH RAVEN RESERVOIR
PINEY RUN/WESTERN RUN
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/06/29	11 00								
CP(T)-			2.100	5.400	0.780	8.000	9.000	0.158	0.166
73/06/29	16 00								
73/07/31	11 00								
CP(T)-			3.150	4.600	0.360	5.800	8.900	0.116	0.120
73/07/31	16 00								
73/08/31	11 00								
CP(T)-				3.500	0.240	10.800	12.000	0.110	0.117
73/08/31	16 00								
73/09/28	11 00								
CP(T)-			2.400	2.000	0.130	10.000	10.000	0.111	0.108
73/09/28	16 00								
74/01/15	11 00								
CP(T)-			9.300	1.500	0.245	9.050	9.050	0.099	0.100
74/01/15	16 00								
74/02/12	[illegible]								
CP(T)-			13.600	3.200	0.450	9.600	10.500	0.096	0.102
74/02/12	15 30								
74/04/02			12.600	2.100	0.270	7.800	8.800	0.106	0.086
74/05/07			6.700	9.000	1.450	9.700	11.000	0.098	0.108
74/06/04	08 00								
CP(T)-			8.700	3.800	0.005K	8.500	8.800	0.120	0.114
74/06/04	16 30								
74/07/02	07 30								
CP(T)-			7.800	2.700	0.260	8.600	8.700	0.121	0.114
74/07/02	16 30								
74/08/06	07 30								
CP(T)-			10.900	5.400	0.450	11.000	11.000	0.109	0.094
74/08/06	16 30								
74/09/03	07 30								
CP(T)-			5.610	9.200	1.550	9.650	10.500	0.109	0.108
74/09/03	16 30								
74/10/22	07 30								
CP(T)-			11.600	2.100	0.091	9.100		0.074	0.090
74/10/22	16 30								

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

2408YA AS2408YA P001000
39 38 29.0 076 50 19.0
MANCHESTER S.T.P.
24 CARROLL COUNTY
T/LOCH RAVEN RESERVOIR
GEORGES RUN/PRETTY BOY RES/GUN POWDER FL
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/07/03	11 00								
CP(T)- 73/07/03	16 00		2.300	15.400	5.100	9.200	12.500	0.064	0.067
73/08/01	11 00								
CP(T)- 73/08/01	16 00		23.000	6.800	4.200	13.000	17.000	0.070	0.065
73/09/05	11 00								
CP(T)- 73/09/05	16 00			5.500				0.076	0.077
73/12/05	10 00								
CP(T)- 73/12/05	15 30		5.100	15.500	5.800	16.000	16.000	0.073	0.067
74/01/22	10 30		7.200	9.300	2.400	10.100	10.500	0.090	0.085
74/02/12	11 00								
CP(T)- 74/02/12	16 00		19.000	7.000	3.700	12.000	12.500	0.094	0.082
74/04/03	11 00								
CP(T)- 74/04/03	15 00		17.600	7.400	3.800	11.500	11.500	0.100	0.097
74/05/01	11 00								
CP(T)- 74/05/01	15 30		9.500	12.000	4.900	12.000	13.000	0.092	0.109
74/08/29	10 00								
CP(T)- 74/08/29	15 00		2.400	6.700	0.050K		17.300	0.139	0.114

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

240830 AS240830 P000000*
39 38 29.0 076 50 19.0
DUTTERER'S OF MANCHESTER
24005 CARROL COUNTY
T/LOCH RAVEN RESERVOIR
GEORGES RUN/PRETTY BOY RES/GUNPOWDER FAL
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/06/28 CP(T)- 73/06/28	07 00 16 30		15.200	0.330	0.270	0.310	0.850	0.026	0.022
73/07/17 CP(T)- 73/07/17	08 00 16 30		16.400	1.300	0.120	0.400	0.870	0.027	0.018
73/08/23 CP(T)- 73/08/23	07 30 16 30		8.700	1.320	0.096	0.490	0.780	0.017	0.021
73/09/20 CP(T)- 73/09/20	08 00 16 00		7.900	1.200	0.400	0.365	0.800	0.029	0.021
73/10/17 CP(T)- 73/10/17	07 40 15 30		17.600	1.250	0.069	0.485	0.860	0.027	0.022
73/11/29 CP(T)- 73/11/29	08 00 15 30		15.000	5.400	0.380	0.195	1.800	0.025	0.022
73/12/13 CP(T)- 73/12/13	08 00 16 00		0.040	2.700	0.360	0.450	1.150	0.030	0.020
74/01/18 CP(T)- 74/01/18	08 00 16 00		7.040	2.400	0.880	0.193	0.980	0.034	0.023
74/02/21 CP(T)- 74/02/21	08 00 16 30		1.480	6.200	1.680	0.170	1.250	0.031	0.028

APPENDIX D

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX E

PARAMETRIC RANKINGS OF LAKES

SAMPLED BY NES IN 1973

STATE OF MARYLAND

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	2402	DEEP CREEK LAKE	550
2	2403	LIBERTY RESERVOIR	268
3	2408	LOCH RAVEN RESERVOIR	215
4	2409	JOHNSON POND	167

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
2402	DEEP CREEK LAKE	0.011	0.450	382.167	6.150	14.800	0.005
2403	LIBERTY RESERVOIR	0.018	1.760	401.833	6.325	14.900	0.006
2408	LOCH RAVEN RESERVOIR	0.023	1.440	429.555	7.133	14.800	0.007
2409	JOHNSON POND	0.098	0.950	458.250	26.225	7.200	0.040

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
2402	DEEP CREEK LAKE	100 (3)	100 (3)	100 (3)	100 (3)	50 (1)	100 (3)	550
2403	LIBERTY RESERVOIR	67 (2)	0 (0)	67 (2)	67 (2)	0 (0)	67 (2)	268
2408	LOCH RAVEN RESERVOIR	33 (1)	33 (1)	33 (1)	33 (1)	50 (1)	33 (1)	215
2409	JOHNSON POND	0 (0)	67 (2)	0 (0)	0 (0)	100 (3)	0 (0)	167